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SILVICAL *Characteristics* OF...

AMERICAN BASSWOOD

(*Tilia americana*)

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FOREST SERVICE

U.S. DEPARTMENT OF AGRICULTURE

THE SILVICAL REPORTS

During 1907 and the following several years the U. S. Forest Service issued a series of silvical leaflets which covered the broad characteristics of a considerable number of major timber species. Since then much new knowledge has accumulated--some of it published in a variety of sources. There is also a considerable store of unpublished silvical information in the files of the forest experiment stations, the forest schools, and some other agencies. To compile this information systematically and make it available to foresters generally, the Lake States Forest Experiment Station is preparing reports on 15 individual species. Similar reports are being prepared by the other Federal forest experiment stations. When completed, these individual species reports will provide the basis for a comprehensive manual of silvics for the important trees of the United States, to be published by the U. S. Forest Service.

This report is one of the series being prepared by the Lake States Station. A preliminary draft was reviewed by several members of our own Station staff and by a number of well qualified staff members of other forest experiment stations, colleges, and universities; Federal, State, and Provincial forestry organizations; and forest industry. Their comments helped the author to make this report more complete, more accurate, and more up to date. Especially helpful reviews were submitted by Professor J. N. Spaeth, University of Illinois; Professors W. C. Ashby and C. E. Olmsted, University of Chicago; John Macon, Consolidated Water Power and Paper Company; E. W. Littlefield, New York Conservation Department; and E. I. Roe, Lake States Forest Experiment Station.

Every effort has been made to ensure the accuracy and completeness of the information concerning the silvical characteristics of each species consistent with a brief treatment of the subject. We shall appreciate it, however, if any errors or omissions of important information are brought to our attention.

M. B. Dickerman

M. B. Dickerman, Director

Cover: A mature American basswood tree growing in a northern hardwood stand in northeastern Wisconsin. Drawing represents leaves.

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SILVICAL CHARACTERISTICS OF AMERICAN BASSWOOD

(*Tilia americana* L.)

by

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American basswood is a large tree indigenous to eastern United States and adjacent Canada (32).[2/] This tree formerly was recognized as *T. glabra* and by other less used names (33).

Other common names for American basswood are American linden, linden, lime, lime-tree, linn, white-wood, beetree, common basswood, and whistle-wood (12, 29, 32, 39, 41).

DISTRIBUTION

The native range of American basswood extends from New Brunswick west to southern Manitoba and from the mountains of South Carolina west to Kansas (fig. 1). Its commercial range[3/] covers the same general area, but is less extensive (fig. 1).

HABITAT CONDITIONS

Climatic Factors

Maximum temperatures of over 100° F. have been recorded throughout the geographic area where American basswood occurs. Minimum temperatures range from -6° at Asheville in western North Carolina to -51° at

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1/ Maintained by the Forest Service, U. S. Department of Agriculture, at St. Paul 1, Minn., in cooperation with the University of Minnesota.

2/ Numbers in parentheses refer to literature cited at end of report.

3/ Commercial range is defined as that portion of the botanical range in which the species attains commercial size and is a major or important part of the type.

AMERICAN BASSWOOD (Tilia americana)

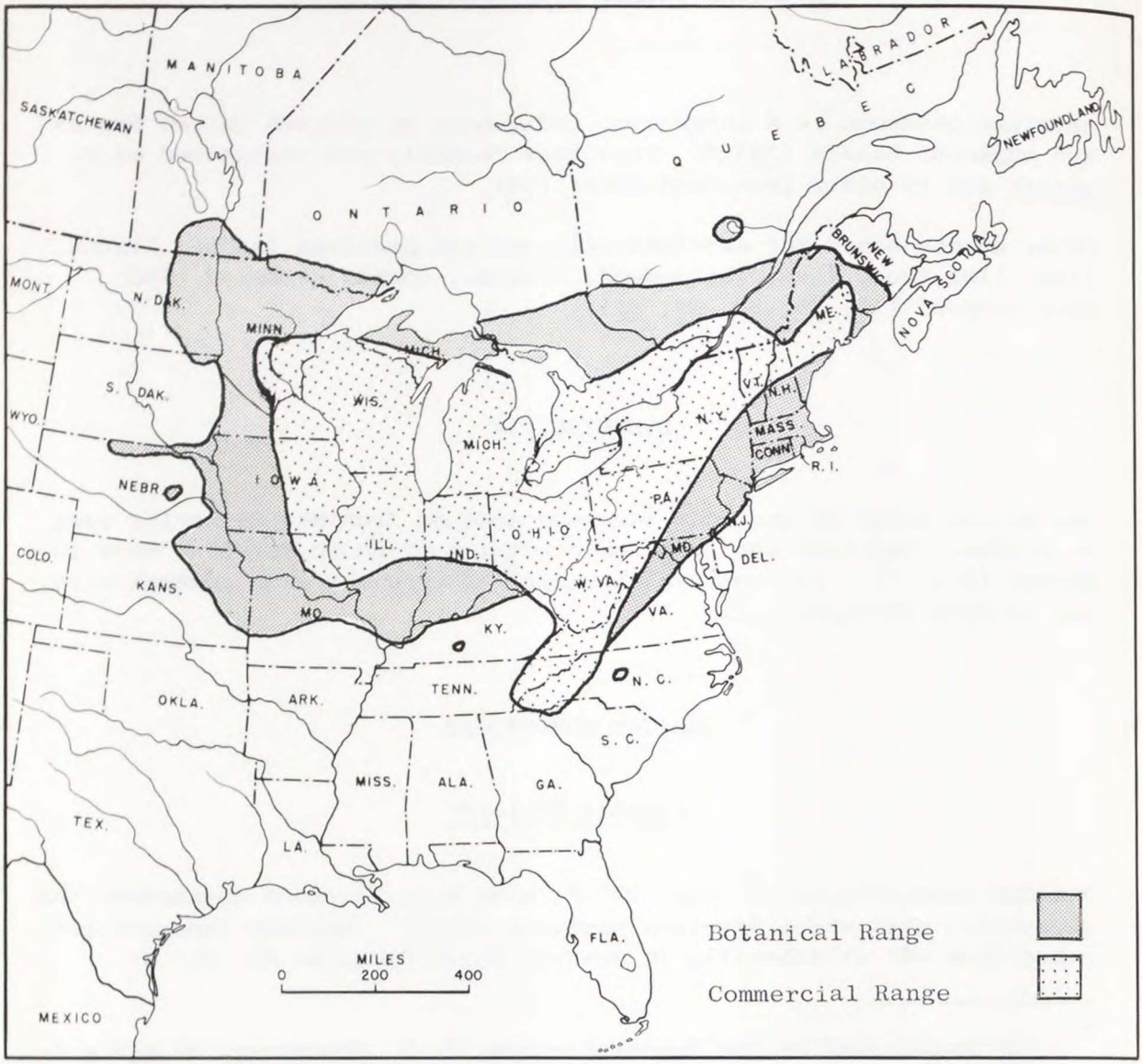

Figure 1.--Botanical and commercial range of American basswood.

Langdon, North Dakota (46). Average July temperatures range from 65° to 80° and average January temperatures vary from 0° to 30° over the botanical range.

The mean annual precipitation varies from 17.90 inches at Langdon, N. Dak., to 60.74 inches at Andrews, N. C. June to August rainfall averages 10 to 14 inches over most of the botanical range of this timber species, but in some localities such precipitation may be as little as 8 inches or as much as 20 inches (46).

Total snowfall averages from 10 inches or less per year in extreme western North Carolina to well over 100 inches in certain localities in Michigan, New York, New England, and southern Ontario and Quebec. The frost-free period varies from 80 days (northern Wisconsin) to about 180 days along the southern geographic limits of the tree (46).

Edaphic Factors

American basswood attains its optimum development on rich, moist, well-drained soils (28). The species is known to be rather exacting in its site requirements. For example, a study in Michigan (51) showed that American basswood was fairly common on sandy loams, loams, and silt loams having clayey subsoils, or, lacking these, on soils where the upper 40 inches of the profile consisted of fine-textured materials. There also was a moderately high occurrence of this tree on sandy loam soils containing limestone, but it was rare or absent on loams, sandy loams, and loamy sands having yellow sand substrata 15 to 30 inches below the surface.

In Washburn County, Wis., glacial till deposits having a colloidal content of 14.0 percent and a moisture equivalent of 12.0 percent at the 24- to 36-inch depth supported stands of northern hardwoods including American basswood (19). However, in this same locality outwash soils with a colloidal content of 2.8 percent and a moisture equivalent of 2.6 percent at the 30- to 36-inch depth originally were forested with pine which currently has been replaced by aspen. It is interesting to note that the red till soils adjacent to the maple-basswood ("Big Woods") region of central Minnesota, where average yearly temperatures are somewhat higher than in Washburn County, Wis., support oak forests instead of northern hardwoods. In both cases, the red tills have the same physical characteristics and glacial origin.

In north central Wisconsin, the highest quality American basswood occurs on friable, slightly podzolized or nonpodzolized loams or on the

less impoverished compacted podzolized loams.[4/] This species also seems to be most abundant on the better soils in southern Ontario and Quebec. More specifically, it usually occurs on loamy tills, "moulded" tills, silt loams, and sandy loams which have been derived from the richer granites, limestones, mica schists, and altered rocks of ferromagnesium nature.[5/]

Occasionally, American basswood occurs on the poorer (drier, more sandy) sites (25). For example, it is reported to be quite common on dune sands adjacent to the southeastern shores of Lake Michigan.[6/] In Canada it sometimes grows on high rocky ridges (11).

According to a recent classification of forest planting-site requirements, this species should be used only on those soils having a minimum silt-plus-clay content of 35 percent, a minimum organic content of 3 percent in the upper 7 inches of the soil profile, and a pH range of 5.5 to 7.3 (52).

Acidity requirements are not particularly exacting for American basswood. Thus in the "Big Woods" region of Minnesota, where this tree is one of the principal timber species, soil samples taken at the 6- to 12-inch depth in 82 profiles were distributed by pH classes from 5.0 to 7.5--more than half of them between 6.0 and 7.0. (16) Several hundred miles farther east in Wisconsin, the pH of red till soils forested with northern hardwoods including basswood ranged from 4.5 to 6.0 (19).

American basswood is recognized as an important soil-improving tree. Its leaves contained the highest percentage of calcium and magnesium among 24 hardwoods or conifers analyzed (34). These same chemical summaries indicated that the foliage of this species ranked fourth in total nitrogen, seventh in total phosphorus, and ninth in total potassium.

4/ Personal communication of April 1956 from John L. Macon, Consolidated Water Power and Paper Company, to the Director, Lake States Forest Experiment Station.

5/ From comments by J. M. Jarvis in a letter of April 1956 (transmitted by J. D. B. Harrison, Chief, Forest Research Division, Canada Dept. of North. Aff. and Natl. Resources, Ottawa, Canada) to the Director, Lake States Forest Experiment Station.

6/ As reported by Professor William C. Ashby, University of Chicago, in a letter of December 1956 to the Director, Lake States Forest Experiment Station.

Physiographic Conditions

American basswood is found up to elevations of about 3,200 feet in the Adirondack Mountains of New York State (29). In the southern Appalachian region this tree occurs at elevations of 3,000 to 5,000 feet (43). Along the central and southern portions of this mountain chain it is most common in the deep coves (often at high elevations) and protected valleys and their adjacent lower slopes.[7/] Such sites are characteristically moist and cool.

As a matter of fact, this species appears to be quite sensitive to differences in microclimate as influenced by topography, aspect, and the character of the soil moisture regime. Thus in Sawyer County, Wis., it is absent on wet flats along the Flambeau River and on adjacent swampy upland sites, scarce on very steep slopes, and relatively common (12.5 to 22.2 percent, by composition, of the northern hardwood stands) on dissected flood plains, moderate slopes, and rolling uplands (8).

The effect of exposure is particularly striking near the western botanical limits of American basswood. For example, along the Missouri River "breaks" in Nebraska, this tree often is very common on lower northern slopes, virtually drops out of the oak-hickory stands which occupy the middle and upper slopes, and entirely disappears on the uplands where the forest cover is supplanted by prairie vegetation (27).

Biotic Factors

Both the relative abundance of shrubs and their representation by species varies with the locality as well as by larger geographic units. On one site American basswood may be associated primarily with scattered individuals or small groups of leatherwood (Dirca palustris) while in another stand a mile or two away the ground area under the forest canopy may be covered with dense, mixed thickets of shrubs such as blackberry (Rubus spp.), American red raspberry (R. idaeus var. aculeatissimus), American elder (Sambucus canadensis). Some shrubs such as greenbrier (Smilax spp.) are typically "southern", whereas others, like Canada yew (Taxus canadensis), are mainly associates of American basswood in the northern part of its range.

7/ Sidney Weitzman, Chief, Division of Watershed Management, Lake States Forest Experiment Station, reports that he has observed American basswood at elevations in excess of 2,500 feet in the high coves of West Virginia.

This tree is not of first importance as a source of food for wildlife. A few animals and birds obtain a limited portion of their total diet from its seed, twigs, and bark (10, 24, 36, 49).

More specifically, in certain localities the seed comprises ½ to 1 percent of the food requirements of bobwhite quail (Colinus virginianus), ½ to 2 percent of the diet of Franklin's ground squirrel (Citellus franklinii), and 5 to 10 percent of that of the eastern chipmunk (Tamias striatus).

A combination of seed and bark accounts for an undetermined portion of the food requirements of the red squirrel (Tamiasciurus hudsonicus), ½ to 1 percent that of the gray squirrel (Sciurus carolinensis), 2 to 5 percent of the total diet of the fox squirrel (S. niger) and porcupine (Erethizon dorsatum), and 5 to 10 percent of the forage consumed by the cottontail rabbit (Sylvilagus floridanus).

American basswood occurs in 16 forest types in the United States (43). These are types number 18 (paper birch), 20 (white pine-northern red oak-white ash), 21 (white pine), 22 (white pine-hemlock), 23 (hemlock), 24 (hemlock-yellow birch), 25 (sugar maple-beech-yellow birch), 26 (sugar maple-basswood), 28 (black cherry-sugar maple), 29 (black cherry), 39 (black ash-American elm-red maple) of the northern forest; and types number 42 (bur oak), 52 (white oak-red oak-hickory), 54 (northern red oak-basswood-white ash), 58 (yellow poplar-hemlock), and 60 (beech-sugar maple) of the Central Forest Region. Usually it is found as scattered individuals or small groups in mixture with other tree species. Nowadays pure stands of this species are rare, but apparently they were not too uncommon earlier in the century (41).

Most of the important eastern hardwoods and conifers occur as the principal or subordinate species in the 16 forest types of which American basswood is a component. However certain of these are much more common than others. For example, eastern hemlock (Tsuga canadensis), red maple (Acer rubrum), and northern red oak (Quercus rubra), are found in all except three of the foregoing types. Other "high-frequency" associates (in from 9 to 12 of the 16 types) include sugar maple (A. saccharum), white ash (Fraxinus americana), yellow birch (Betula alleghaniensis), black cherry (Prunus serotina), and American elm (Ulmus americana).

American beech (Fagus grandifolia), paper birch (Betula papyrifera), sweet birch (B. lenta), white oak (Quercus alba), yellow-poplar (Liriodendron tulipifera), balsam fir (Abies balsamea), eastern white pine (Pinus strobus), and red spruce (Picea rubens) occupy a place of secondary importance (they are found in from 5 to 8 of the 16 types).

An additional 36 tree species (31 hardwoods and 5 conifers) occur in mixture with American basswood in a few (1 to 4) of these 16 forest types. Because of their large size, relative abundance, or high

commercial value the following are worthy of mention: black walnut (Juglans nigra), butternut (J. cinerea), slippery elm (Ulmus rubra), black locust (Robinia pseudoacacia), green ash (Fraxinus pennsylvanica), bigtooth aspen (Populus grandidentata), quaking aspen (P. tremuloides), eastern cottonwood (P. deltoides), hackberry (Celtis occidentalis), silver maple (A. saccharinum), white spruce (Picea glauca), tamarack (Larix laricina), and northern white-cedar (Thuja occidentalis).

LIFE HISTORY

Seeding Habits

Flowering and Fruiting

Drooping clusters of yellowish-white perfect flowers appear in June or July about 6 to 8 weeks after leafing. During this period the flowers are pollinated by insects.

The fruits, described as round or egg-shaped capsular or nutlike structures ripen in September or October and fall soon afterward (48). Usually the pericarp encloses a single seed, but it may contain as many as four. There are 3,000 to 8,000 clean fruits per pound. The seed can be stored satisfactorily at room temperatures for 2 years. If it must be held longer than this, a lower temperature (about 40° F.) must be maintained.

The soundness of fresh seed averages about 80 percent. The germinative capacity of the seed averages 29 percent (48).

Both the pericarp and the testa are crustaceous. Partly as a result of the impermeable testa, and partly because of the need for afterripening the embryo, the seed of this tree requires special treatment to obtain satisfactory germination in the nursery (4, 31, 44). In nature germination of some seed probably is delayed for 1 to 4 years (48).

Seed Production

Good yields of seed are produced almost every year (48). Trees produce viable seed at an age of 15 years; the maximum seed-bearing age is reported to be 100+ years.

Seed Dissemination

The seeds of American basswood are borne on long-stalked cymes which are attached to narrow leaf-like bracts 4 to 5 inches in length (25). These bracts persist on the mature fruit clusters and act as miniature, rapidly whirling "parachutes" when the cymes are dropped from the twigs in late fall, winter, and early spring. Wind and animals disperse the fruit (48).

Information is not available on the distance the seed clusters are carried by turbulent air currents, but it seems likely that most of them fall within one or two tree heights of their point of origin. Animals, especially small rodents which transport and store the basswood nutlets, may increase the seeding radius quite substantially.

Vegetative Reproduction

Of all the hardwoods indigenous to the United States, few equal or surpass American basswood in its capacity to reproduce by stump sprouts. Often the species can be identified at some distance because of the circular clusters of this vegetative regeneration (fig. 2) (25). As early as 1907 this (coppicing) method was recommended for "renewing old stands" (47). For best results, winter felling, low stumps, and thinning the sprout clumps to two or three selected individuals at the end of the first year were recommended.

Figure 2.--The seven trees in this American basswood sprout-cluster were 35 years old and had a d.b.h. range of 7.3 inches to 9.9 inches in 1954. Chilsen Timber Harvest Forest, Lincoln County, Wis.

The principal objection to coppice is its tendency to become defective and lose its early vigor at the age when seedling stock begins to make its best growth. In one case reported, 32 percent of the mixed hardwoods, including American basswood, originating from sprouts were partially rotten at the base of the trees (50). Only 28 percent of the saplings and poles--but 70 percent of the sawtimber stems 10 inches and larger at d.b.h.--had butt rot.

In some instances important compositional changes in forest stands can be traced to the vigorous sprouting habit of this species. For example, repeated presettlement burning by Indians in certain localities in Minnesota all but eliminated sugar maple, northern red oak, and elms (Ulmus spp.) and resulted in species with aggressive sprouting habits--American basswood and eastern hophornbeam (Ostrya virginiana)--taking over these sites (16).

Seedling Development

Establishment

Germination is epigeous. Under certain conditions it may be delayed as long as 4 years (48). Mineral soil is the best seedbed. The first-year seedlings are characterized by their palmately lobed cotyledons (25). During its initial development, a basswood seedling has a single stout root, but this soon is supplemented by a number of laterals which firmly anchor the small tree (47). Regeneration of this species which came in naturally under the canopy of a "linden" forest in southeastern Nebraska showed the following physical development during the first 2-year period from seed (27):

Year	Total height of stem	Root development	
		Total depth	Total spread
	(Inches)	(Inches)	(Inches)
1st	2.2	8.0	3.0
2nd	3.7	8.4	7.2

Early Growth

In west central Wisconsin, American basswood seedlings attain an average height of 6 inches in 2 to 3 years, depending on the amount of competing vegetation and the density of the forest overstory.[8/] Measurements taken over a 20-year period in Indiana showed that young basswood trees 6 to 9 inches tall at the time of the first measurement added about 5 inches of net height growth per year (17). According to one estimate, the annual rate in southern Wisconsin is about 12 to 18 inches.[9/]

Generally there is a dearth of well established seedlings of American basswood in the forest types where this species occurs as a main stand component (16, 18, 30). A few of the factors responsible for this situation have been evaluated.

It is known, for example, that losses of first-year seedlings often are quite heavy.[10/] Sometimes the young trees are destroyed by animals, especially cottontail rabbits.[11/] The latter probably is the most serious animal pest of American basswood, particularly in States such as Illinois where the acreage of woodlands is very small in comparison to that of agricultural lands. Under these conditions, rabbits often decimate the seedlings of this species by devouring all the above-ground portions of the stems. The seedlings may lose out in competition with herbaceous vegetation, woody shrubs, and the regeneration of other tree species. In one case-study the following mortality was experienced: (1) First summer, 39 trees; (2) first winter, 19 trees; (3) second and third years combined, 14 trees. At the end of the third growing season only 28 of the original sample of 100 basswood seedlings were still alive (27).

It is obvious that one of the keys to managing this timber tree is to develop silvicultural techniques that will assure the survival of a higher percentage of its seedling regeneration.

8/ Unpublished data, Lake States Forest Experiment Station.

9/ Observations by Dr. J. T. Curtis, Professor of Botany, University of Wisconsin, as reported in his letter of May 4, 1956, to the Director, Lake States Forest Experiment Station.

10/ Comments by Professor William C. Ashby, University of Chicago, in a letter of December 6, 1956, to the Director, Lake States Forest Experiment Station.

11/ Comments by J. Nelson Spaeth, Department of Forestry, University of Illinois, in a letter of April 1956 to the Director, Lake States Forest Experiment Station.

Growth and Yield

American basswood is a species which makes rather uniform diameter growth in closed stands, the average rates varying moderately by crown classes (18). Dominant trees in the woodlands of southeastern Minnesota averaged about 10 annual rings per radius-inch as compared to 13 to 17 rings for codominants, and 14 to 17 rings for intermediates. The most vigorous height growth of this species occurs when the trees are 2 to 8 inches in diameter (table 1). Origin of the growing stock (seedlings, stump sprouts, or root suckers) appears to have no significant effect on total height for stems of identical d.b.h.

When allowed to attain full maturity on good sites, American basswood is an extremely large and stately tree. It has a narrow, oblong, or pyramidal crown composed of many relatively small branches (11). Specimens 120 to 140 feet tall and 4 to 4½ feet at d.b.h. are a matter of record (12, 25, 28, 41). Basswood has a deep wide-spread system of strong lateral roots (11).

In closed forest stands, it is characteristically straight-boled and clear of limbs for 50 percent or more of its total height. Extremely old trees often are buttressed the first 4 to 6 feet above the ground (fig. 3).

Figure 3.--The front stem of the twin American basswoods in the left foreground is buttressed conspicuously to a height of about 6 feet. This tree is 29 inches in diameter at breast height and well over 100 years in age. Cairns-Ellsworth Timber Harvest Forest, Pierce County, Wis.

Table 1.--Average height of American basswood by diameter classes

Diameter at breast height (Inches)	Total height	
	Southern Wisconsin[1/]	Lower Michigan and northern Wisconsin[2/]
	Feet	Feet
2	16	21
4	30	37
6	42	49
8	51	60
10	57	68
12	62	74
14	66	78
16	70	82
18	72	86
20	75	90

1/ Curve values for 231 trees from second-growth stands in Crawford and Vernon Counties, Wis. (unpublished data, Lake States Forest Expt. Sta.).

2/ Curve values for 75 trees from old-growth stands (21).

Currently, the largest recorded American basswood is in Monroe County, Pa.((2). This tree is 16.5 feet in circumference (63 inches in diameter) at breast height, 106 feet in total height, and has a crown width of 75 feet.

Most of the "big" timber trees of this species nowadays are 20 to 30 inches d.b.h., but occasionally a 36- or 38-inch specimen, having a merchantable height of four or five 16-foot logs, still is cut from some isolated or forgotten patch of virgin woods.

Internal rot is a serious silvicultural consideration in managing old-growth American basswood. The outward appearance of these trees can be extremely misleading, for as often as not stems without an external blemish may be hollow from the stump halfway to the top of the tree. Such hidden defects make it extremely difficult to estimate log quality

in standing timber. By contrast, the wood of this species usually is remarkably sound in young, rapidly growing second-growth trees.[12/]

An investigation of white basswood (Tilia heterophylla) in the southern Appalachian region showed that the incidence of decay was highest in stems with old basal wounds and in those trees having the largest diameters (26). Comparable studies are needed for American basswood.

Estimates of its longevity vary from 100+ years (48) to 140 years (25). Apparently information on this point, however, is not conclusive and needs to be supplemented by additional data.

Reaction to Competition

In a classification which recognized five levels of shade effect--namely, very tolerant, tolerant, intermediate, intolerant, and very intolerant--the majority of botanists, ecologists, and foresters rated American basswood either tolerant (majority opinion) or intermediate (3). Several attempts have been made in recent years to express tolerance, or somewhat closely related ecological indices, in numerical terms. When such criteria are used, this tree usually is assigned a value of about 8.0 in a species list where light-demanding quaking aspen and jack pine (Pinus banksiana) are rated 1.0 and shade-enduring eastern hemlock and sugar maple, 10.0 (9, 14, 22).

There is some evidence that the seedlings and saplings of American basswood are relatively less tolerant than older trees of this same species. The extremely high mortality of its seedling regeneration in closed stands and the typical umbrella-topped, short-boled form of suppressed saplings add weight to this hypothesis.

Observations in northern Wisconsin indicate that American basswood reproduction often dies during the cotyledon-leaf stage in small-sized forest openings, whereas the seedlings of so-called "less tolerant" species, such as white ash, black cherry, and yellow birch, successfully invade these same areas.[13/]

The place of relative importance which this tree holds in the natural plant association varies considerably according to its geographic

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12/ Unpublished observations by John L. Macon, Consolidated Water Power & Paper Co., in northern Wisconsin.

13/ Comments in a letter of April 27, 1956, from John L. Macon, Consolidated Water Power & Paper Co., to the Director, Lake States Forest Experiment Station.

location (16, 19, 23). Generally speaking, the role of American basswood as a major dominant in the climax forest is most pronounced near the western botanical limits of the species.

Limiting Factors

Inadequate annual precipitation is reported to limit the natural distribution of this tree, particularly in the Plains States (1). Even within its botanical range, local soil moisture conditions may be too extreme on certain sites for it to become successfully established. For example, the species rarely invades swampy land, nor is it usually found on very dry soils.

Fire often causes basal wounds which subsequently are infected by wood-rotting fungi. Two of the most important of these are the yellow cap fungus (Pholiota adiposa) (7) and a polypore (Polyporus resinosus) (5) which cause heartrot and saprot, respectively, in American basswood. Because of its rapid and vigorous sprouting capacity, which delays the formation of dead wood on broken limbs and tops, the advance of decay in the crown is slower in this species than in several others of the hardwoods associated with it (45).

The foliage of American basswood may be affected periodically by anthracnose (Gnomonia tiliae), black mold (Fumago vagans), or leaf spot (Cercospora microsora) (35). These diseases may spoil the appearance of ornamental and street trees for a season or two but seldom cause any permanent damage.

American basswood is attacked by various insects, but none of them is considered a limiting factor in the natural distribution of the tree. The principal defoliators are the spring cankerworm (Paleacrita vernata), fall cankerworm (Alsophila pometaria), white-marked tussock moth (Hemerocampa leucostigma), gypsy moth (Porthetria dispar), walkingstick (Diapheromera femorata), and the variable oak leaf caterpillar (Heterocampa manteo). The linden borer (Saperda vestita) attacks and often slowly kills overmature, weakened, or young trees. The tree also is a host for a long list of boring, leaf-feeding, gall-forming, and sucking insects of minor or secondary importance from the standpoint of the damage they cause in any single year (13).

In certain localities cottontail rabbits feed so heavily on the seedlings and small saplings of American basswood that the regeneration of this tree is virtually eliminated from the stand.[14/]

14/ Comments by J. Nelson Spaeth, University of Illinois.

SPECIAL FEATURES

The sweet-scented flowers of American basswood yield a light-colored highly prized honey (39).

In the past, the long, tough bast fibers of the inner bark were used in making rope, cord, fish nets, mats, and similar articles (12, 39).

The wood is used for lumber, venetian blinds, sash-and-door stock, picture frames, moulding, furniture, woodenware, veneer, cooperage, and apiarist's supplies (6). The soft, close-grained lumber has excellent working and gluing properties, and accepts and holds paint well. American basswood is not a favored pulpwood species, because its cellulose yield and fiber characteristics are not as good as most of the hardwoods usually associated with it.

Old hollow trees of this species furnish wildlife sanctuaries and breeding places for racoons (Procyon lotor), opossums (Didelphis marsupialis), squirrels, and rabbits (42).

RACES, HYBRIDS, AND OTHER GENETIC FEATURES

In common with most of the hardwoods in the United States, the question of racial diversity in American basswood has received little study. However, there is every reason to expect that ecotypes or races eventually will be discovered for this species, which encompasses a tremendous geographical area. Detailed investigations also are needed for the entire genus because of the present conflicting opinions in the taxonomic literature with regard to the proper number of species and varieties of Tilia (20, 25, 28, 33, 37, 38, 39, 41).

Vegetative cells of normal basswood trees have 41 pairs (82) of chromosomes (15).

Hybrids have been reported between American basswood and the following species: Silver linden (Tilia tomentosa), littleleaf linden (T. cordata), silverpendent linden (T. petiolaris), and bigleaf linden (T. platyphyllos) (40).

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This is the eleventh of the silvical reports being prepared by the Lake States Forest Experiment Station. Already published are:

Station Paper 44 - Red pine
Station Paper 45 - Black spruce
Station Paper 47 - Rock elm
Station Paper 49 - Quaking aspen
Station Paper 50 - Sugar maple
Station Paper 52 - Tamarack
Station Paper 54 - American elm
Station Paper 55 - White spruce
Station Paper 59 - Slippery elm
Station Paper 61 - Jack pine

Ensuing reports will cover the following species:

Bigtooth aspen
Black maple
Balsam poplar
Northern white-cedar

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Chemical Control of Brush and Trees in the Lake States.
Paul O. Rudolf and Richard F. Watt.
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Wood Pallets in the Minneapolis-St. Paul Area: An Outlet for Low-Grade Hardwoods.
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